

RADIAL JAW BIOPSY FORCEPS

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BACKGROUND OF THE INVENTION

This invention relates to biopsy forceps and more particularly to unique handler actuation wire and homologous jaw construction for those forceps.

A number of different types of biopsy forceps are in common use, typically in conjunction with endoscopic assistance. Ordinarily, these devices are of complicated construction, requiring the manufacturing and machining of precise miniaturized components, which are therefore generally quite expensive.

One early example of flexible forceps is shown in U.S. Patent 3,895,636 (1975) to Schmidt, wherein a pair of cup shaped jaws having an annular rim mate with a hub and a sharpened trocar. The jaws in this embodiment are of a nature which requires machining for the edge, each jaw being different from the other jaw.

U.S. Patent 4,887,612 to Esser et al, shows a similar biopsy forceps which utilizes a cam linkage to effectuate the cup shaped jaws toward and away from one another. The jaws shown in this patent are made from stainless steel and likewise, require expensive machining.

U.S. Patent 4,763,668 to Macek et al, shows a biopsy forceps whose cup shaped forceps are driven by a linkage arrangement. Each pivot point in the linkage establishes a new place for stress, wear and breakage. This is similar to the linkage

1 assembly shown in U.S. Patent 4,721,116 to Schintgen et al. A
2 needle between the forceps shown in this patent, is retractable as
3 the forceps close.

4
5 U.S. Patent 3,921,640 to Freeborn, shows a surgical
6 instrument manufactured from a single piece of molded plastic.
7 The instrument may have any of various forms of jaws including an
8 arrangement of teeth for holding towels or surgical dressing.

9
10 U.S. Patent 4,200,111 shows a pair of spring biased jaws
11 which are slidably disposed within the end of a trocar. The jaws
12 are moved inwardly and outwardly from the trocar by movement from
13 a twisted wire.

14
15 U.S. Patent 4,669,471 to Hayashi, shows a biopsy forceps
16 device having a pair of cups attached by a pivot pin, with several
17 linkages between the cups and the operating wire, which are
18 likewise, connected by pivot pins, the pins being welded or fused
19 to their components by the use of laser welding.

20
21 U.S. Patent 4,815,460 to Porat et al, shows a medical device
22 for gripping, having a pair of jaws which are identical to one
23 another. The jaws have an array of teeth disposed completely
24 thereacross. The teeth are divided longitudinally across each jaw
25 and are out of phase from one another by a half a pitch. The
26 instrument is utilized for gripping purposes. A further device is
27 shown in U.S. Patent 825,829 to Heath. This appliance utilizes
28 two different sets of engaging jaws to accomplish its cutting
29 purpose.

30
31 It is an object of the present invention to provide a forceps
32 device which overcomes the disadvantages of the prior art.

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3

1 It is a further object of the present invention to provide a
2 cutting device having a pair of jaws, wherein each jaw may be a
3 duplicate of its opposing jaw.

4
5 It is yet a further object of the present invention to
6 provide a cutting device which is self-aligning which permits
7 greater tolerance in the dimensions of the components in their
8 manufacture.

9
10 SUMMARY OF THE INVENTION

11
12 The present invention comprises an improvement in biopsy
13 forceps wherein a pair of jaws are formed from a casting. Each
14 jaw of the pair of jaws of the biopsy forceps may be a duplicate
15 of the other jaw. Each jaw is somewhat hemispherically shaped
16 having an elongated portion which extends proximally into a cutter
17 tang. Each cutter jaw has a generally U-shaped distalmost end on
18 which is defined a plurality of radially disposed teeth. The
19 teeth on one side of the longitudinal centerline of the jaw are
20 displaced by one-half pitch from the corresponding teeth on the
21 other side of the longitudinal centerline on that jaw. The
22 displacement by one-half pitch of the teeth on one side of the jaw
23 relative to those corresponding teeth on the other longitudinal
24 side of the jaw permits the same casting to be used for both the
25 upper and lower jaws. The radially disposed array of teeth on
26 each of the jaws permits a self-aligning feature therewith, thus
27 compensating for the slightly looser tolerances found in the
28 casting manufacturing technique.

29
30 Each jaw extends proximally and terminates in a tang, as
31 aforementioned. Each tang is arranged so as to receive a joggled
32 pull wire therethrough. Each jaw is mated with one another about

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1 a clevis pin which is cast unitarily with a clevis. The clevis
2 extends into a housing which is crimped to a main coil, the
3 proximal end of which extends into a handle having means for
4 articulating the jaws. Each joggled pullwire from the tang on the
5 proximal end of each jaw flexibly extends through the main coil
6 and into the hub of the handle at the proximal end of the forceps
7 assembly.

8
9 The handle comprises a central shaft about which a
10 displaceable spool is disposed. The central shaft has a
11 longitudinally directed stepped diameter bore extending therein on
12 its distal end, and a thumb ring on its proximalmost end. The
13 proximal end of the coil extends into the bore on the proximal end
14 of the central shaft. The bore in the central shaft of the handle
15 has a stepped configuration. The distal end of the bore having a
16 slightly larger diameter than the second or intermediate bore, or
17 the third or proximal end of the bore in the central shaft. A
18 locking coil is arranged to mate within the stepped large outer
19 diameter (distal end) of the central shaft. The locking coil has
20 an inner diameter which is slightly smaller than the outer
21 diameter of the main coil extending from the cutter jaw assembly
22 to the handle. The main coil is screwed into the locking coil
23 disposed within the central shaft. A sheath which acts as a
24 strain relief, is disposed distally of the locking coil about the
25 main coil within the central shaft. The sheath holds the locking
26 coil within the first stepped bore in the central shaft. The
27 strain relief is bonded to the bore of the central shaft. The
28 proximalmost end of the joggled pull wires extend through the
29 proximal end of the main coil and into a thin anti-kink tube in
30 the narrowest third stepped bore in the central shaft. The cross
31 pin fits through a slot at the midpoint of the central shaft. The
32 slot is in communication with the third bore therein. A cross pin

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1 mates with the slot across the central shaft. The proximalmost
2 end of the joggled pull wires are locked into an opening in the
3 cross pin. The ends of the cross pin mate with slots in the spool
4 so as to facilitate corresponding motion in the joggled pull
5 wires.

6
7 Proximal movement of the spool with respect to the central
8 shaft effectuates a pull on the joggled pull wires so as to create
9 a pivotable motion of the tangs on the proximal end of the
10 cutters, to cause the cutter jaws to engage to one another.

11
12 Movement of the spool distally with respect to the central
13 shaft effectuates a compression on the pull wire thus causing
14 arcuate movement of the tangs on the proximal end of each jaw to
15 force a pivoting motion about the clevis pin thus opening the
16 respective jaws.

17 BRIEF DESCRIPTION OF THE DRAWINGS

18
19 The objects and advantages of the present invention will
20 become more apparent when viewed in conjunction with the following
21 drawings, in which:
22

23
24 Figure 1 is a side elevational view in section, of a biopsy
25 forceps assembly;
26

27 Figure 2 is a side elevational view of the distalmost end of
28 a biopsy forceps assembly with a needle, with its cutter jaws
29 being opened;
30

31 Figure 3 is a plan view, partly in section, of the distal end
32 of a biopsy forceps without a needle;

Figure 4 is a side elevational view partly in section of the biopsy forceps shown in Figure 3 with its jaws opened;

Figure 5 is a plan view, partly in section, of the distal end of a biopsy forceps assembly, with a needle;

Figure 6 is a side elevational view partly in section, of the biopsy forceps shown in Figure 5; and

Figure 7 is a side elevational view in section, showing part of the handle at the proximalmost end of a biopsy forceps assembly.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail and particularly to Figure 1, there is shown a biopsy forceps assembly 10, having a distal end 12, comprising a jaw assembly 14, and a proximal end 16 comprising a handle 17, spool 19 and thumb ring 21 for manipulation of the assembly. The jaw assembly 14 comprises a pair of jaws 18, each of which is a duplicate of the other. Each jaw 18 as may be seen in Figs. 2 and 3, is a generally elongated somewhat hemispherically shaped structure having a distalmost end and a proximalmost end. Each jaw 18 has on its distalmost end, an array of teeth 20 generally radially directed about a point "R", as exemplified in Fig. 3. Each jaw 18 has a generally longitudinal centerline as may be seen in Figs. 3 and 5. The teeth 20 on one side of the longitudinal centerline of each jaw 18 being displaced by one half pitch from the corresponding teeth 20 on the other side of the longitudinal centerline on that jaw 18. The displacement by one half pitch by the teeth on one side of the jaw 18 is relative to those corresponding teeth 20 on the other

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1 longitudinal side of the jaw 18 permits the same casting to be
2 used for both the upper and lower jaws of the jaw assembly 14.
3 The radial arrangement of the teeth 20 as best seen in Figs. 3 and
4 5 require each jaw 18 when they close onto one another to
5 automatically mate and effectuate proper alignment therebetween.
6 The self-alignment permits each jaw 18 to be manufactured by an
7 investment casting technique which is inheritantly less expensive
8 than the typical prior art jaws which are machined and which
9 distalmost teeth are either non-existent or they are transverse to
10 the longitudinal centerline the jaws, which jaws inheritantly fail
11 to have any positive cutting edge at their distalmost ends. The
12 casting of each jaw 18 also permits a looser tolerance
13 therebetween which is characteristic of the casting manufacturing
14 technique without any loss in effectiveness of those jaws.
15

16 Each jaw 18 has a proximalmost end which comprises a tang 24.
17 Each tang 24 has a generally semicircular recess position 26 on
18 its outer side thereof. The recessed portion 26 may be seen most
19 clearly in Figs. 3 and 5, and then a side view in Figs. 2, 4 and
20 6. A bore 30 extends transversely through the midpoint between
21 the distal and proximalmost ends of each jaw 18. Each jaw 18 is
22 mated with one another and so as to each be levered about a clevis
23 pin 28 which extends through the bore 30 on each respective jaw
24 18. Each jaw 18 has an annular boss 33 disposed about the outer
25 face of its bore 30, as shown in Figs. 3 and 5. The boss 33 acts
26 as a bearing surface to reduce the typical friction found on prior
27 art forceps. The clevis pin 28 is received in a hole 32 in clevis
28 34 as shown in Figs. 3 and 5. The clevis 34 extends proximally,
29 as shown in Figs. 2 - 6, into a hub 40. The clevis 34, the
30 housing 40 and clevis pin 28 are made from a common casting. The
31 clevis pin 28 unitarily extending from one of the sidearms 29 of
32 the clevis 34.

1 A main tubular coil 50 shown in Fig. 2 at its distal end
2 thereof, has a portion of its periphery ground flat, as at 52. The
3 flattened distal periphery of the main coil 50 permits a more
4 solid anchoring between the inside of the hub 40 and the distal
5 end of the main coil 50 when the two are crimped together,
6 obviating the need for adhesives, soldering or welding.

7
8 An FEP sheath 54 extends from the distal end of the main coil
9 50 therethrough into the central shaft 56 of the handle 17 as
10 shown in Figs. 2 and 7. This sheath 54 acts as a bearing between
11 a pair of pull wires 60 and the lumen of the main coil 50.

12
13 The distalmost end of each pull wire 60 has a Z-bend therein.
14 the Z-bend of each pull wire 60 has a first portion 62 which is
15 rotatably disposed in the recess 26 in the tang 24 of each cutter
16 jaw 18. The Z-bend has a second portion 64 which extends through
17 a bore 66 in the proximalmost end of the tang 24, as best shown in
18 Figs. 3 and 5. A ninety degree bend 68 between the second portion
19 64 and the main pull wire 60 eliminates the pinching common to
20 prior art loop design wires. Each pull wire 60 has a reflex curve
21 70 as shown in Fig. 2 as well as in Figs. 6 and 7, ⁴ extending
22 between their distalmost ends and the distalmost end of the main
23 coil 50. The reflex curve 70 helps to open the cutter jaws 18
24 when the spool 19 on the handle 17 is displaced distally thereto.

25
26 Figs. 2, 5 and 6 shows the distal end of the biopsy forceps
27 assembly 10 with a flat needle 80 disposed between the two cutter
28 jaws 18. The needle 80 has a pointed distalmost end 82 that
29 terminates just within the cutter jaws 18 when closed, and has
30 tail 84 comprising its proximalmost end which extends within the
31 distalmost end of the main coil 50. The needle 80 has a central
32 opening through which the clevis pin 28 may extend as shown in

1 Figs. 3 and 5. The needle 80 is flat, and as such may be disposed
2 between the two tangs 24 of each cutter jaw 18 as shown in Fig. 5.
3 In cutter jaw assembly 14 without the needle therein, a washer 90
4 is disposed between the two cutter jaws 18 on the clevis pin 28.

5
6 The proximal end of the main coil 50 and the proximal end of
7 the pull wires 60 extend into handle 17 at the proximal end 16 of
8 the biopsy forceps assembly 10. The handle 17 comprises a central
9 shaft about which a displaceable spool 19 is disposed. The
10 central shaft has a longitudinally directed stepped diameter bore
11 92 extending therein, as shown in Figs. 1 and 7. The proximal end
12 of the main coil 50 extends into the bore 92 on the proximal end
13 of the central shaft. The bore 92 extending into the central
14 shaft has a three stepped configuration. The bore 92 on the
15 distalmost end of the central shaft has a large first diameter 94
16 as shown in Fig. 7 which steps to a smaller second diameter 96
17 which subsequently steps down to a smaller yet third diameter bore
18 98. A locking coil 100 is disposed against the first largest
19 diameter bore 94 in the central shaft. The main coil 50 has an
20 outer diameter slightly larger than the inner diameter of the
21 locking coil 100 and is threadedly received therethrough. The
22 main coil 50 thus extends to and abuts the handle 17 adjacent the
23 second stepped bore 96 of the bore 92 in the central shaft. The
24 pull wires 60 disposed through the inner lumen of the main coil
25 extend therethrough and into the smallest portion 98 of the bore
26 92 in the central shaft. A strain relief sheath 102 is disposed
27 distally to the locking coil about the main coil 50 within the
28 largest bore 94 in the central shaft. The strain relief sheath
29 102 extends slightly distally of the distalmost end of the central
30 shaft, and is bonded to the inner walls of the largest bore 94 by
31 a solvent which is directed thereto through a hole 104, as shown
32 in Fig. 7. The strain relief sheath 102 limits twist and movement

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1 of the main coil 50 with the bore 94 while preventing a sharp bend
2 of the coil 50 at the distal end of the handle 17. The
3 proximalmost end of the pull wires 60 extend through the proximal
4 end of the main coil 50 as aforementioned and through and anti-
5 kinking tube 109, and are locked into a cross pin 110, as shown in
6 Fig. 1, which cross pin 110 mates with a slot 112 disposed across
7 the central shaft of the handle 17. The slot 112 is in
8 communication with the axial bore 92 in the central shaft. The
9 proximalmost end of the pull wires 60 are locked into the cross
10 pin 110 by a set screw 114 as shown in Fig. 1. The ends of the
11 cross pins 110 mate with a slot 116 in the spool so as to lock the
12 cross pin 110 therewith. Movement of the spool 19 which is
13 disposed about the central shaft thereby effectuates movement of
14 the puller wires 60 disposed within the main coil 50, the distal
15 ends of which are attached to the tangs 24 on the cutter jaws 18
16 as shown in Figs. 1 and 2.

17
18 Thus there has been shown a biopsy forceps assembly which can
19 be made in a very cost effective manner for an improved biopsy
20 sample. The cutter jaws and clevis support of the biopsy forceps
21 each being made of a cast material permitting a far less expensive
22 manufacture because of its simplicity permitting one jaw design
23 and its self-aligning radially directed distal jaw teeth
24 effectuating its cutting effectiveness as well as its ease of
25 assembly. The pull wire arrangement with each particular jaw
26 eliminates the prior art multiple linkages which have frictional
27 problems and potential for breakage therewith. The spool design
28 for the grasping of the pull wires in regard to the handle
29 therewithin facilitates a one-handed operation thus permitting the
30 physician use of his other hand for other purposes.